COMMONWEALTH OF AUSTRALIA

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Warning

CHARLES DARWIN UNIVERSITY

Family Name	
Given Names	
Student Number	
Teaching Period	Semester 2 Special/Summer Semester, 2016

FINAL EXAMINATION	**DURATION**
SBI209 – Design and Analysis of Biological Studies	Reading Time: **10** minutes Writing Time: **180** minutes

INSTRUCTIONS TO CANDIDATES

Answers should be written in the booklet provided.

Please ensure that your Name and Student Number are written clearly in the space provided at the top of the booklet.

Note that questions ARE of equal value.

Read ALL questions carefully.

Answer on the supplied examination material/s only.

EXAM CONDITIONS

You may begin writing from the commencement of the examination session. The reading time indicated above is provided as a guide only.

This is a RESTRICTED OPEN BOOK examination

Any calculator is permitted

No handwritten notes are permitted

Hard copy, unannotated English translation dictionary only

ADDITIONAL AUTHORISED MATERIALS	EXAMINATION MATERIALS TO BE SUPPLIED
No additional printed material is permitted	1 x 8 Page Book 1 x 20 Page Book Formula Sheet/s Statistical Table/s

THIS EXAMINATION IS PRINTED DOUBLE-SIDED.

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Twelve (12) short-answer questions

Total number of marks for this section: 180

Answers should be written in the booklet provided.

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are written clearly in the space provided at the top of the booklet.

Note that questions ARE of equal value.

Read ALL questions carefully.

Marks for each question are indicated.
Suggested time allocation for this section: 180 minutes.
Note: All data are invented.
Questions commence on following page.

Question 1

Describe a situation where a cluster sampling scheme would be better than a stratified sampling scheme and give two reasons why it would be better.

(15 minutes = 15 marks)

Question 2

The sex of many reptiles is partly determined by temperature, so the numbers of males and females in a population are not always similar. For a certain lizard, in a particular area, the percentage of females is 80%, or 0.8. If nine (9) lizards are caught, calculate the probability of the following outcomes:

(i) One (1) out of nine (9) is female.

(ii) Five (5) out of nine (9) are female.

(iii) Seven (7) out of nine (9) are female.

(15 minutes = 15 marks)

Question 3

A biologist studying reproduction in lizards counts the numbers of males and females at three locations. Using the data in the table below, test the following hypothesis:

H_0: The ratio of male to female lizards is the same at the three locations.

Table 1: Counts of male and female lizards at three locations.

	Southern	**Middle**	**Northern**
Male	18	28	35
Female	24	14	18

(15 minutes = 15 marks)

Question 4

A new factory is going to be built near a forest containing the last individuals of a rare species of parrot. A study is done to test the following null hypothesis: "H_0: The factory will not decrease the numbers of parrots." Discuss the consequences of making Type I, and Type II, errors when testing this null.

(15 minutes = 15 marks)

Question 5

Blue-fin tuna has an average sustained swimming speed of 2.8 m/sec (metres per second), with a standard deviation of 0.7 (fishbase.org). Assuming that speed is normally distributed, calculate the proportion of tuna able to swim at the following speeds:

(i) Slower than 2.1 m/sec.

(ii) Faster than 3.5 m/sec.

(iii) Faster than 4.2 m/sec.

(15 minutes = 15 marks)

Question 6

A sports psychologist claims to have developed a new hypnotic relaxation treatment that can greatly increase performance on the basketball court. The Western Emus lost their last game by 93 points so decide to try it and have all the players take the treatment after training for a week. They win their next game by 27 points and conclude that the treatment works. Is this conclusion valid? If not, why not?

(15 minutes = 15 marks)

Question 7

In 150 spells of bowling in a cricket test match, Brett Lee got a total of 150 wickets, with the statistics shown in the table below (www.howstat.com.au). The table below (Table 2) shows that, for example, in 21 innings he got no (0) wickets, in 41 innings he got one (1) wicket and in 33 innings he got two (2) wickets. Test the following null hypothesis:

H_0: Wickets are distributed (or occur) at random through innings.

Table 2: Counts of wickets per innings for Brett Lee in test cricket.

Wickets→	**0**	**1**	**2**	**3**	**4**	**5**
Count→	21	41	33	28	17	10

(15 minutes = 15 marks)

Question 8

A nutritionist is investigating diet and has eighteen (18) subjects taking part in a test of three kinds of diets. One group of six (6) subjects eats their normal diet; one group six (6) subjects has a reduced kJ diet which is also low in fat; the final group six (6) subjects also has a reduced kJ diet but low in carbohydrates (carbs). At the start of the study there was no difference among the groups in average weight. The results given below were recorded after three months. Complete the analysis below, and do any other procedures required, to test the following null hypothesis:

H_0: Mean weight after three months is the same for all three diets.

Table 3: Mean weight with three different diets.

Diet→	**Normal**	**Low fat**	**Low carb**
Weight (kg)	100.04	84.17	79.62

Table 4: Partially completed analysis of data.

Source	**SS**	**df**
Among	1222.52	2
Within	1993.01	15
Total	3215.53	17

(15 minutes = 15 marks)

Question 9

The owner of an aquarium shop is interested in how his goldfish swim. One day when the shop is quiet, he measures the length (mm) and speed (m/sec) of seven (7) goldfish ranging in size from small to large (fishbase.org). Using the data in the table, test the null hypothesis below:

H_0: Swimming speed is not correlated with length.

Table 5: Speed and length of seven (7) goldfish.

Sample→	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Speed (m/s)→	0.28	0.75	0.67	1.15	1.30	1.40	1.90
Size (mm)→	4	6	7	9	13	14	16

(15 minutes = 15 marks)

Question 10

Anti-fouling paint is used on the bottom of boats to stop plants and animals attaching and growing. A common active ingredient is copper, with an upper limit of four (4) ppm being used in some situations. In the table below (Table 6) are measurements of concentrations in five (5) samples from each of two (2) batches of paint. For each batch, test the following null hypothesis:

H_0: The mean amount of copper is less than or equal to 4 ppm.

Table 6: Copper concentration (ppm) in two batches of anti-fouling paint.

Batch 1→	**Sample 1**	**Sample 2**	**Sample 3**	**Sample 4**	**Sample 5**
Copper (ppm)→	2.60	4.25	3.55	3.75	4.36
Batch 2→	**Sample 1**	**Sample 2**	**Sample 3**	**Sample 4**	**Sample 5**
Copper (ppm)→	4.07	3.94	3.62	3.86	3.70

(15 minutes = 15 marks)

Question 11

A study was done looking at the effect of two different kinds of pain killers – paracetamol (par) and ibuprofen (ibu) – on headaches, with results shown in the tables below. There were four (4) subjects in each of the nine (9) groups. Subjects scored their pain, after taking the drug (or, for the controls, just waiting) on a scale of 1 (none) to 5 (very bad). 4.State appropriate null hypotheses, complete the analysis, draw conclusions about these hypotheses, and about the effects of the two drugs.

Table 7: Mean pain score for the subjects in each of the nine (9) treatment groups.

	No Par	**1 tablet Par**	**2 tablet Par**
No Ibu	4.7	3.5	2.4
1 tablet Ibu	3.7	2.2	2.1
2 tablet Ibu	2.5	1.8	2.2

Table 8: Partially completed analysis of data.

Source	**SS**	**df**	**MS**	**F**
A: Par	13.61	2	6.81	69.40
B: Ibu	10.95	2	5.47	
A×B	5.08	4	1.27	
Within/Error	2.65	27		
Total	32.29	35		

(15 minutes = 15 marks)

Question 12

Does relaxing music help people sleep? A sleep therapist has six (6) people record how many hours they sleep with no music playing then, the following night, with music playing. Using the data in the table, test the following null hypothesis:

H_0: Mean time asleep with no music equals the mean time with music.

Table 9: Hours sleep during the night with or without music for six (6) patients.

	Subject					
	1	**2**	**3**	**4**	**5**	**6**
No music	5.9	6.3	5.6	8.8	13.9	7.1
Music	5.4	6.8	6.4	10.5	13.6	6.2

(15 minutes = 15 marks)

FORMULAS

Note – you may **NOT** need to use all of these.

1. $\Pr(r) = \frac{n!}{r!(n-r)!} \times p^r(1-p)^{n-r}$

2. $\Pr(r) = \frac{e^{-\mu}\mu^r}{r!}$

3. $t = \frac{\bar{X}_1 - \bar{X}_2}{\mathrm{SE}}$

where

$$\mathrm{SE} = \sqrt{\frac{s_c^2(n_1+n_2)}{n_1 \times n_2}}$$

$$s_c^2 = \frac{s_1^2(n_1-1)+s_2^2(n_2-1)}{(n_1+n_2-2)}$$

$$df = (n_1 + n_2 - 2)$$

4. $r = \frac{C_{\mathrm{xy}}}{\sqrt{\mathrm{SS}_x \times \mathrm{SS}_y}}$

where

$$C_{\mathrm{xy}} = \sum \mathrm{XY} - \frac{\sum X \sum Y}{n}$$

$$\mathrm{SS}_x = \sum X^2 - \frac{(\sum X)^2}{n}$$

$$\mathrm{SS}_y = \sum Y^2 - \frac{(\sum Y)^2}{n}$$

5. $r_s = 1 - \frac{6\sum d^2}{(n^3-n)}$